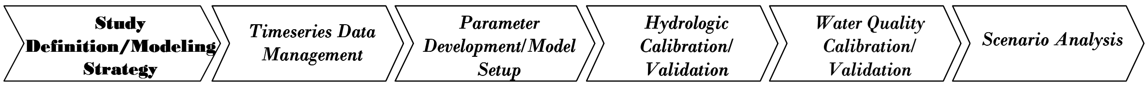
Exercise 5 – Segmentation

BASINS/HSPF Application Steps



Question addressed in this section:

1) What is segmentation?
2) What are the advantages of adding additional segments to my model?
3) What are some disadvantages of including a model segment for each subbasin?
4) How can I add a meteorological segment to my model?
5) How do I change the meteorological segment ID?
6) How do I associate a meteorological segment with its corresponding contributing land area?
7) How do I confirm that the new meteorological segments have been added?
8) How do I divide a reach?

A. Introduction to Segmentation

QUESTIONS ANSWERED:

1) What is segmentation?
2) What are the advantages of adding additional segments to my model?
3) What are some disadvantages of including a model segment for each subbasin?

As discussed in Singh (1997), the accuracy of model output is dependent on the spatial and temporal sizes of discretization. Setting the level of discretization of a model in HSPF is known as “segmentation,” or the process of creating model segments. Model segments are often created to account for differences in meteorological data, topography, soils variations, etc. that may require varying meteorological data inputs or land segment parameter values over the study area.

Model segments are sub-areas of a watershed with uniform parameters and meteorological inputs that are connected by a reach network. According to Singh (1997), the critical properties needed to represent the heterogeneity of a model segment include (a) rainfall or important meteorological data, (b) soil type, (c) land use conditions, (d) reach characteristics, and (e) any other important physical characteristic (infiltration, overland slope, etc.).

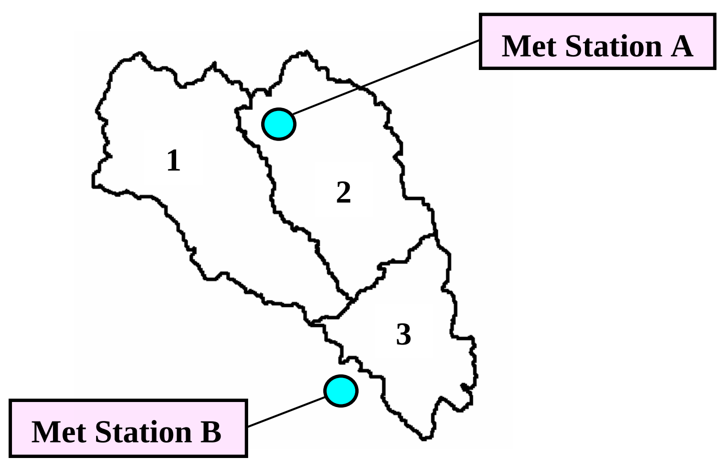
Dividing a watershed into two or more model segments has several advantages. Especially in large subbasins where more than one representative meteorological station may be required to adequately represent climate variations. Once segmented, it is possible to assign a separate meteorological station to each model segment. This is particularly important when considering available precipitation data. Assigning appropriate meteorological stations to model segments provides greater accuracy. As discussed above, segmentation also accounts for spatial variation in other meteorological data and in physical characteristics such as soil types, slopes, and distance of overland flow.

When considering segmentation, you should also take into account that it is possible to have too many segments in your model. It is generally not best to include a model segment for each subwatershed (as is done by using the 'Individual' segmentation option in WinHSPF) because to do so would imply a greater level of detail than is generally possible to parameterize. It also provides a greater opportunity for error when modifying parameter values, is computationally less efficient, and makes calibration difficult.

As mentioned previously, one important basis for model segmentation is the variation in meteorological data across the study area. When a model is segmented to account for differences in meteorological data, those model segments are sometimes referred to as *meteorological segments*, or met segments. The following discussion will explain met segmentation.

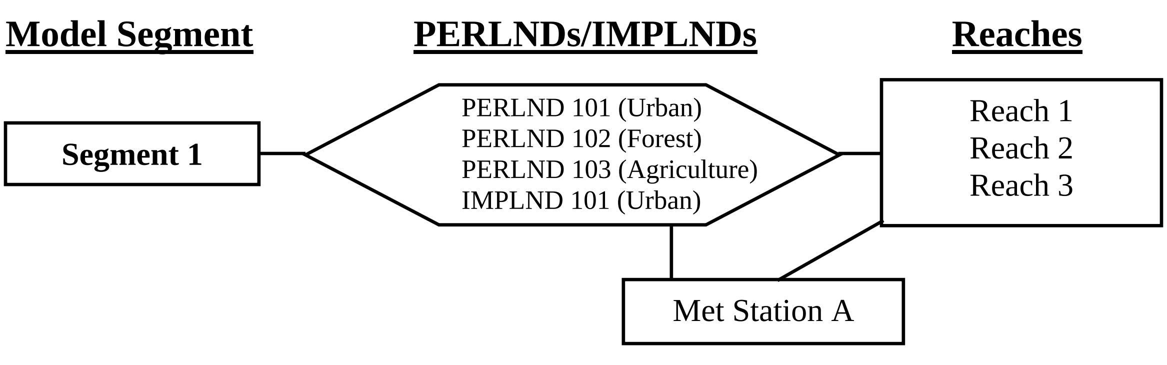
Model segments based on differences in meteorological characteristics

Look at the following watershed diagram:

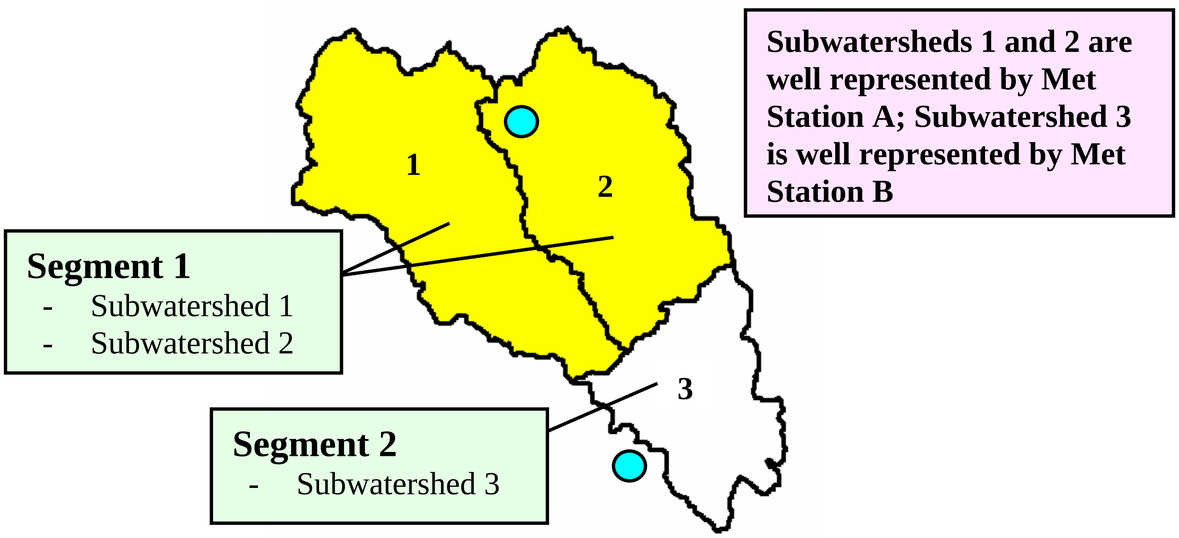


The watershed consists of 3 subwatersheds. Notice that there are two meteorological stations near the watershed that are representative of different portions of the drainage.

WinHSPF, using the "Grouped" segmentation option, would create an input file with the following relationship:

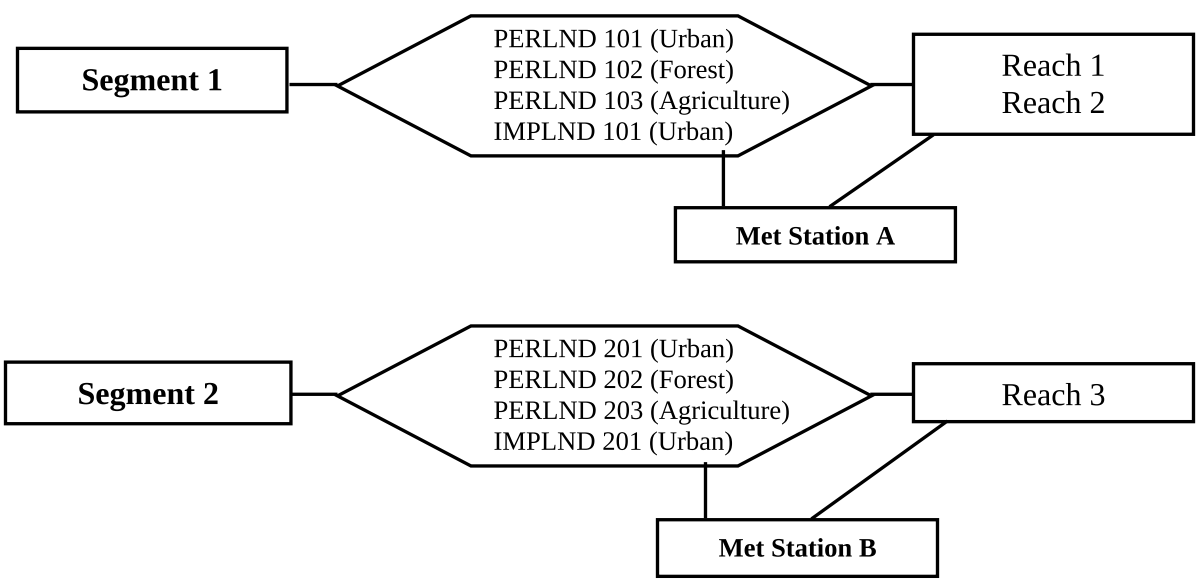


In this situation, each PERLND/IMPLND takes into account the area associated with each landuse in all three of the subwatersheds and uses the same meteorological data for all three subwatersheds. Since we have two met stations that are representative of different portions of the study area, it makes sense to create an additional met segment; one segment (we'll call it Segment 1) that will be comprised of Subwatersheds 1 and 2 and will use meteorological data from Station A, and one (Segment 2) that will be comprised of Subwatershed 3 and will use data from Station B.



In this scenario, there would be two met segments, and therefore two sets of PERLNDs/IMPLNDs. The following diagram shows the relationship between the met segments and PERLNDs/IMPLNDs after the additional met segment has been added.

Model Segments **PERLNDs/IMPLNDs** **Reaches**

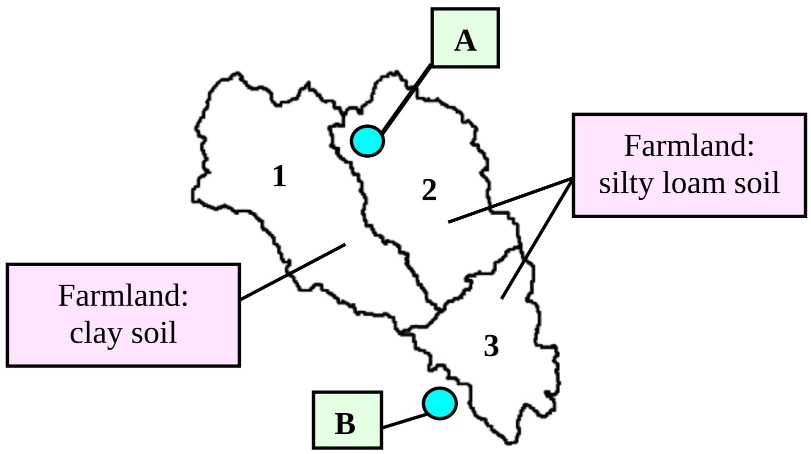


Note: Keep in mind that a model segment based on differences in meteorological characteristics is often called a met segment.

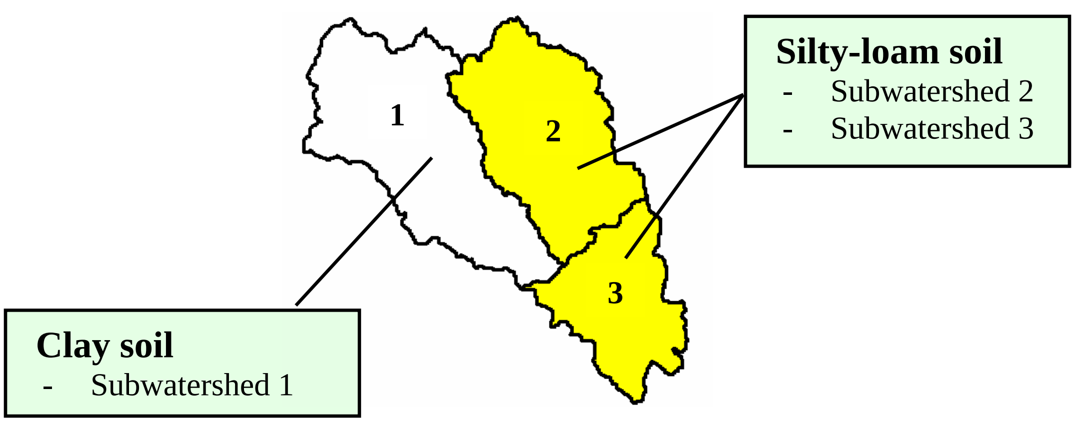
In this scenario, all the meteorological time series associated with Met Station A would be applied to the land area associated with PERLND 101-103, IMPLND 101, and Reach 1-2. Similarly, the time series associated with Met Station B would be applied to PERLND 201-203, IMPLND 201, and Reach 3.

Model segments based on differences in physical characteristics

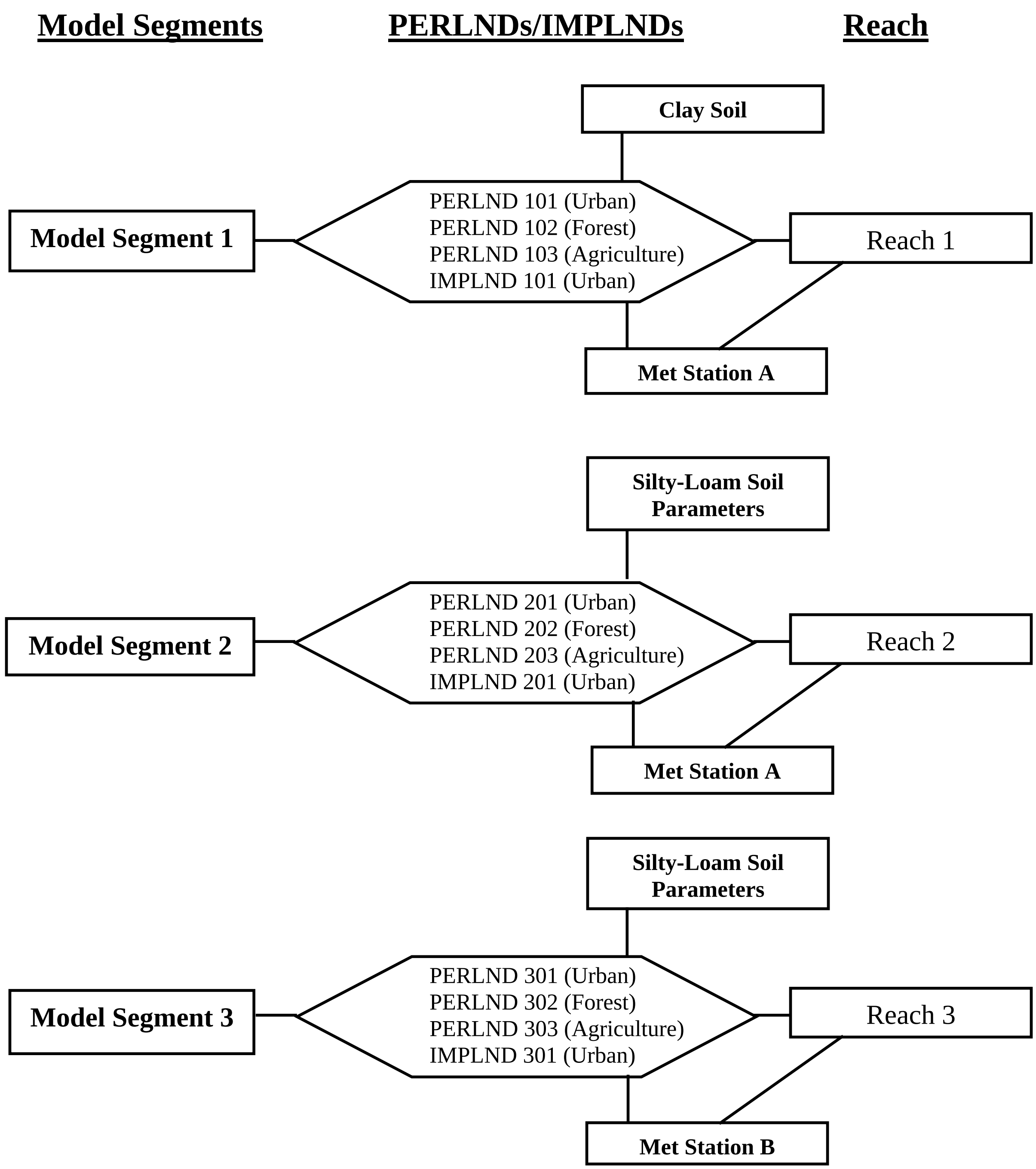
Recall that heterogeneity of physical characteristics may be the basis for model segmentation. In such cases, two different model segments can use the same met data but will have different model parameter assignments. Using the example watershed above, let's assume another situation in which we desire to segment our model based on differences in physical characteristics in addition to the met segmentation. In this scenario, let Subwatershed 1 represent farmland where the predominant soil type is clay. Let Subwatersheds 2 and 3 represent farmland where the predominant soil type is silty-loam.



Although all three subwatersheds have a portion of their total area that is the same land use category (agriculture land), it is desirable to create two model segments because the physical characteristics of clay and silty-loam are significantly different. These differences will affect factors such as infiltration, subsurface water storage, surface roughness, root depth, etc. and therefore, require the model to be parameterized accordingly.



Recall that a met segment is a type of a model segment. In the previous example we divided our model into two met segments, and therefore two model segments. In this example, we will divide Met Segment 1 into two separate model segments resulting in a total of three model segments with the following relationship:



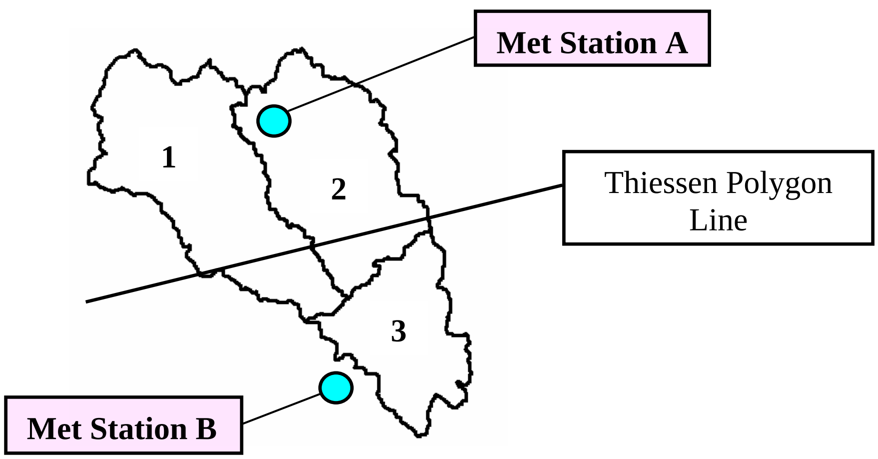
Remember that in this scenario Model Segment 1 and Model Segment 2 will use the same meteorological data, but will have many different input parameters. Model Segment 2 and 3 will use different meteorological data, but will likely have the same or similar input parameters.

How is Segmentation related to Delineation?

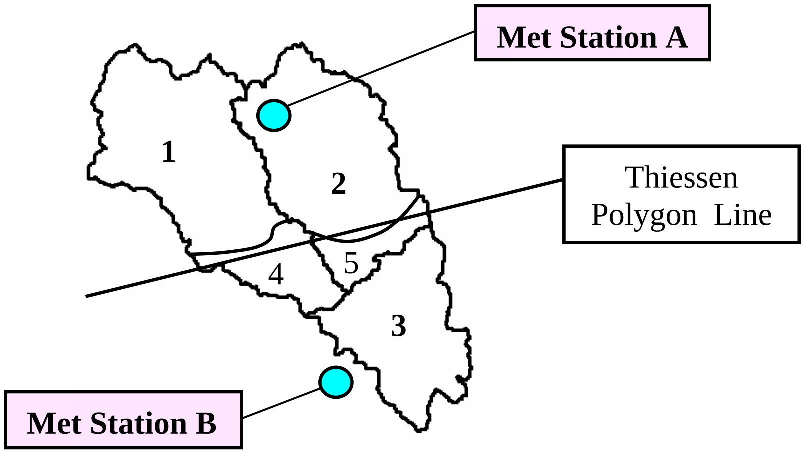
In Exercise 2, Watershed Delineation, you began the process of segmentation as you became familiar with the BASINS watershed delineation tools. In fact, delineation is a part of the segmentation process. As you decide how best to segment your study area based on meteorologic data and physical characteristics, you very well might find that you need to revisit your subbasin delineations.

One common method of assigning meteorologic data to model subbasins is through the use of Thiessen polygons. Thiessen polygons are created by joining the perpendicular bisectors of imaginary lines connecting the met stations on a map, which essentially assigns each subbasin to the nearest met station (not the most representative weather station, just the nearest weather station).

In the example below, a Thiessen polygon line has been drawn between the 2 met stations. Subbasins above the Thiessen line are assigned to Met Station A, and subbasins below the line are assigned to Met Station B.



Assigning Met Station A to subbasins 1 and 2 may or may not be acceptable depending on whether it is the most representative meteorological station of the subbasin area. A modeler will have to make this judgment given local knowledge of the area being modeled. Once the most representative meteorological station is selected, a modeler may decide to further delineate subbasins to increase modeling accuracy by dividing subbasins 1 and 2 into additional subbasins 4 and 5, as shown below.



Met Station B would be assigned to subbasins 3, 4, and 5, and the smaller versions of subbasins 1 and 2 would be assigned to Met Station A.

You can see from this example that watershed delineation can often be an iterative process, needing refinement during segmentation in order to capture spatial variation in meteorologic inputs and other physical characteristics of the study area.

B. Adding a Met Segment

QUESTIONS ANSWERED:

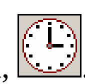
4) *How can I add a met segment to my model?*
5) *How do I change the met segment ID?*
6) *How do I associate a met segment with its corresponding contributing land area?*

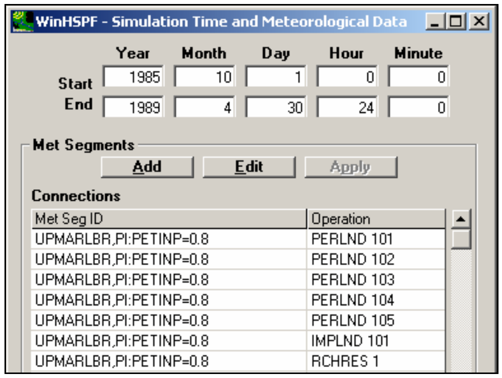
In the following section, we will add a met segment to our model using WinHSPF.

1. From the **Start** menu under **Programs**, select **BASINS** and then **WinHSPF**.

2. Navigate to *c:\basins\modelout\segment* and select “*segment.uci*.”

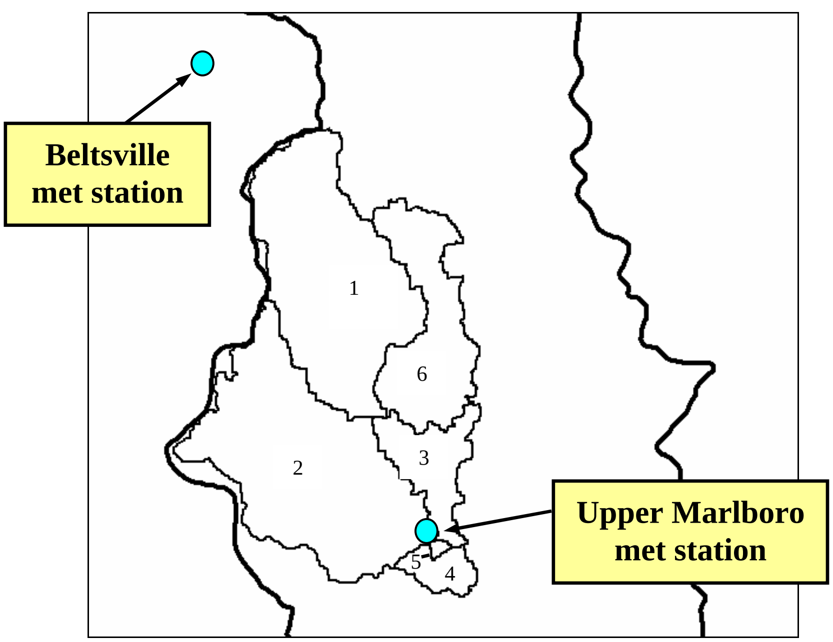
3. Click OPEN.

4. Click the “Simulation Time and Meteorological Data” button, . Your screen should look like the following:



Note: Notice in the “Met Seg ID” column, each ID code is followed by PI:PETINP = 0.8. This specifies that for pervious and impervious land segments, the evaporation time series will be multiplied by 0.8 in order to estimate potential evapotranspiration from the pan-evaporation time series. Likewise, for reach segments, the evaporation time series will be multiplied by 0.8 in order to estimate potential evaporation from the pan-evaporation time series.

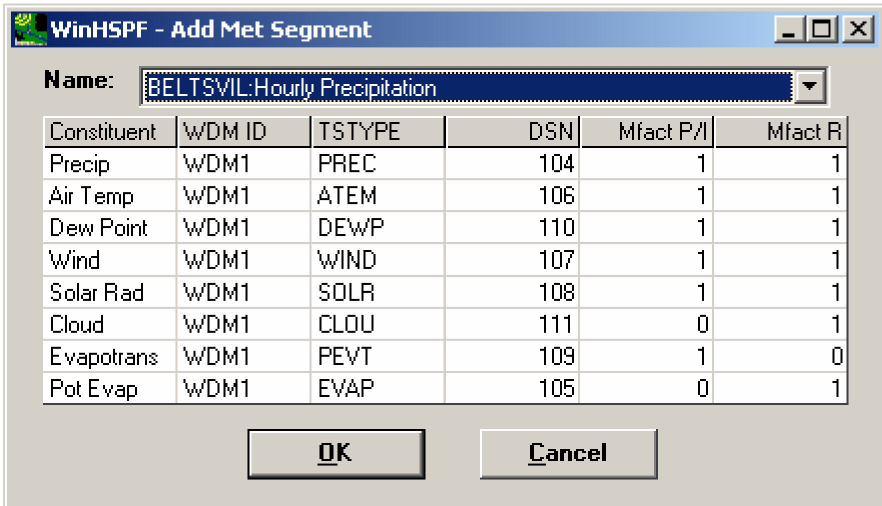
Scroll through the “Met Seg ID” list and notice that there is only one met segment (all the PERLND, IMPLND and RCHRES segments have the same met segment ID). This met segment uses precipitation data from the Upper Marlboro met station. Look at the schematic below. Notice that the Beltsville met station is actually closer to and (we will assume for training purposes) more representative of subwatersheds 1 and 6 than the Upper Marlboro station.



In the following section, we will create another meteorological segment so that we can apply the more representative precipitation data (from the Beltsville station) to the upper portions of the Western Branch study area. We will use the meteorological data from the Upper Marlboro station for all required meteorological time series other than precipitation.

5. Click ADD.

6. From the “Name:” menu, select “BELTSVIL: Hourly Precipitation.”



Note: We previously imported the Beltsville hourly precipitation time series to our output WDM file (*Seg_WB.wdm*). Notice that the DSN number for the precipitation data is “104.” This is the DSN number found in *Seg_WB.wdm* for the Beltsville hourly precipitation data.

Note: WinHSPF automatically assigns DSN numbers to the rest of the meteorological data time series. The time series corresponding to the DSN numbers listed in this table for air temp, dew point, wind, solar radiation, cloud, evapotranspiration, and potential evapotranspiration don’t exist. Recall that for the new met segment, we decided to use the precipitation data from the Beltsville station, and all other met data from the Upper Marlboro station. We need to change the DSN numbers to specify actual time series corresponding to data collected at the Upper Marlboro station and stored in the *Seg_WB.wdm* file.

7. Change the values in the “TSTYPE” (where necessary) and “DSN” columns to the following:

Constituent	TSTYPE	DSN
Precip	PREC	104
Air Temp	ATMP	122
Dew Point	DEWP	151
Wind	WIND	141
Solar Rad	SOLR	161
Cloud	CLDC	131
Evapotrans	EVAP	111
Pot Evap	EVAP	111

Note: It is important that the values in the "TSTYPE" table are exactly as shown in the table above. The DSN numbers corresponding to the Marlboro meteorological time series can be found in the *.wdm* file.

8. In the cell that corresponds to "Evapotrans" and "MFACT P/I," enter "0.8."This will estimate potential evapotranspiration for the pervious and impervious land segments.

9. In the cell that corresponds to "Pot Evap" and "MFACT R," enter "0.8."This will estimate potential evaporation for the reach segments.

10. Click OK.

Now that we have added a new met segment, we need to specify to which reaches and land use segments the new met segment will be applied.

11. In the "Operation" column, **double click** "RCHRES 1." A menu will appear in the "Met Seg ID" column.

12. Select "BELTSVIL, PI:PETINP=0.8, R:POTEV = 0.8."

13. Make sure the row corresponding to "RCHRES 1" is selected and click APPLY. The following screen will appear:

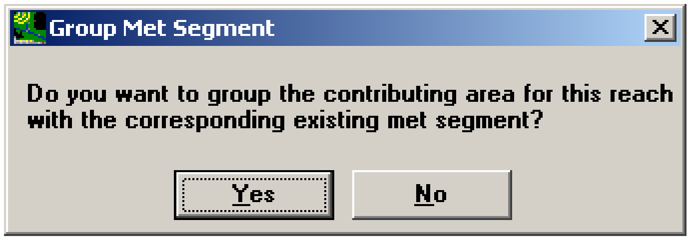
14. Click YES. The new PERLNDs / IMPLNDs will correspond to the new met segment you created. Scroll down and notice that PERLNDS 201-204 and IMPLND 201 have been added to the list.

Note: Because neither Reach 1 nor Reach 6 have any wetlands contributing to them, it is not necessary for WinHSPF to create a PERLND 205 land segment.

15. In the "Operation" column, **double click** "RCHRES 6."

16. From the "Met Seg ID" menu, select "BELTSVIL, PI:PETINP=0.8, R:POTEV = 0.8."

17. Make sure the row corresponding to "RCHRES 6" is selected and click APPLY. The following screen will appear:



18. Click YES. This specifies that we would like to use the Beltsville precipitation data for all PERLNDs and IMPLNDs contributing to Reach 6.

The new land use segments are now associated with RCHRES 1 and RCHRES 6. The land use segments for these two reaches are grouped together as in the following example:

Forest land contributing to reach 1 = 5784 acres
\+ Forest land contributing to reach 6 = 2774 acres
\---
Total forest land contributing to Reach 1 and Reach 6 = 8558 acres

PERLND 201 consists of the total forest land contributing to Reach 1 and Reach 6, and has a total area of 8558 acres. The other PERLNDs (202, 203, and 204) and IMPLND 201 are created similarly for pervious urban land, agriculture land, barren land, and impervious urban areas, respectively.

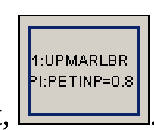
C. Viewing the New Met Segment

QUESTIONS ANSWERED:

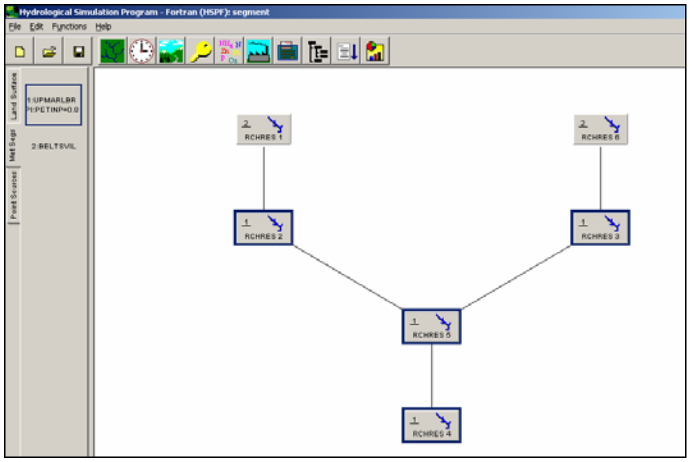
7) How do I confirm that the new met segments have been added?

One way to verify that the new met segment was successfully added to the model is to view the met segment schematic in the main WinHSPF window.

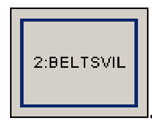
1. With the main WinHSPF window open, click the "Met Segs" tab (located at the left side of the screen).

2. Click the button that corresponds to the original met segment, 

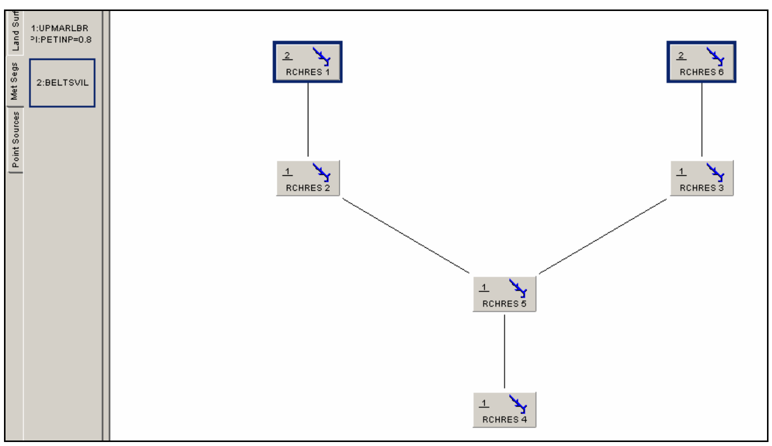
. Your schematic should look like the following:



Notice that the blocks corresponding to RCHRES 2, RCHRES 3, RCHRES 4, and RCHRES 5 are highlighted, and that these blocks have a "1" in the upper left corner. This means that they are assigned to met segment "1."

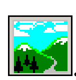
3. Click on the button that corresponds to the new met segment, 

. Your schematic should look like the following:

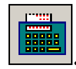


RCHRES 1 and RCHRES 6 are highlighted and have a "2" in the upper left corner. This means they have been assigned to the second met segment (corresponding to the Beltsville station).

Two other ways to verify that the new met segment was successfully added to the model are to look in the "Land Use Editor" and the "Input Data Editor."

6. Click the "Land Use Editor" button, . Notice that PERLNDs 201-204 and IMPLND 201 appear in the "Sources – Selected:" box.

7. Click OK.

8. Click the “Input Data Editor” button, .

9. **Double click** PERLND → PWAT → PWAT-PARM2. Notice that the new met segments appear in the table. The parameters for PERLNDs 201-204 are identical to those for PERLNDS 101-104. You can change parameter values for the new met segment.

10. Click OK.

11. Click CLOSE.

D. Note on Adding Model Segments

WinHSPF does not provide explicit means to add a ‘model’ segment (other than met segments). A model segment that is based on differences in physical characteristics may be added one of two ways. The more straightforward way is to add the new set of PERLND and IMPLND operations to the Operation Sequence block, set the parameter values for those new operations, and then edit the Schematic block to set the land use areas contributing to those new operations. The other way, which is less straightforward but takes advantage of more advanced WinHSPF capabilities, is to follow the instructions in Section B for adding a met segment, but with a slight variation. After adding the met segment, change the met segment associated with the specified reaches back to original met segment, and then update the PERLND and IMPLND parameters as needed. Doing so will result in a new model segment based on differences in physical characteristics and not differences in met data.

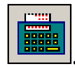
E. Dividing a Reach

Closely related to meteorological segmentation is the issue of reach/channel segmentation. In most cases, it is best to consider reach segmentation in watershed delineation, but it is possible to divide a channel after delineation is complete. The following are examples of conditions in which it might be appropriate to segment a reach:

1) Significant differences in flow due to either a flow input source or withdrawal (point source, tributary, groundwater seep, diversion)
2) Significant changes in channel slope
3) Changes in roughness (Manning’s N)
4) Changes in channel geometry
5) Obstructions (dams, etc)

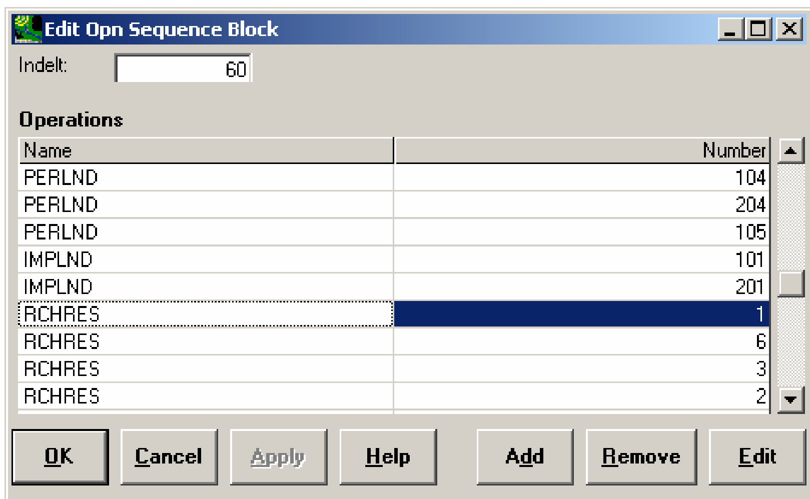
As with watershed delineation, an important factor when considering segmentation is the availability and location of data. Since output from the model is available only at reach outlets, it is best to divide a reach where data is available and/or model output is desired.

For the purposes of this exercise, we will assume the following hypothetical situation: Water quality data has been collected in RCHRES 1 at the midpoint of the reach. We would like to use this data for calibration to ensure that we are modeling the headwaters of the system accurately. Since output is only available at reach outlets, we will break RCHRES 1 into two reaches and appropriately adjust the landuse areas associated with each.

1. Click the "Input Data Editor" button, .

2. **Double click** OPN SEQUENCE.

3. Scroll down and select the record that corresponds to Reach 1 (the reach we would like to split). Your screen should look like the following:



4. Click ADD.

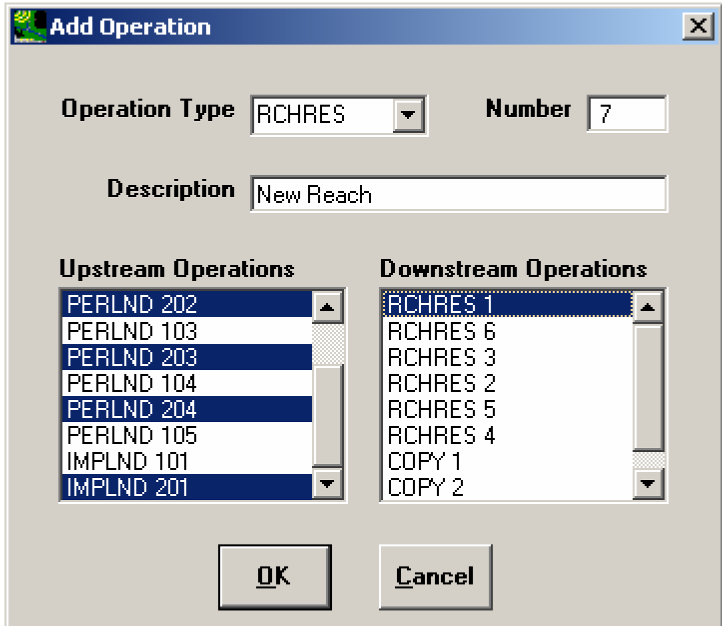
5. In the "Operation Type" box, select "RCHRES."

6. In the "Number' box, enter "7."

7. In the "Description" box, enter "New Reach."

8. In the "Upstream Operations" box, select the following: PERLND 201, PERLND 202, PERLND 203, PERLND 204, IMPLND 201.

9. In the 'Downstream Operations" box, select "RCHRES 1."



10. Click OK to exit the "Add Operation" window.

11. You should see a new record in the "Operations" table; scroll down and notice that RCHRES 7 has been added to the list. Click OK to exit the "Opn Sequence Block" window.

12. Click CLOSE.

Next, we will adjust the land use areas that will contribute to the new reach and Reach 1.

13. Click the "Land Use Editor" button, .

14. Look at the table (located toward the bottom half of the window). Notice that the area values for RCHRES 7 are all "1," signifying 1 acre of area from PERLNDs 201-204 and IMPLND 201 to Reach 7. We need to adjust these values to represent the amount of area draining to each reach.

Source ID	Source Description	Target ID	Target Description	Area (Acres)
PERLND 201	Forest Land	RCHRES 7	New Reach	1
PERLND 202	Urban or Built-up La	RCHRES 7	New Reach	1
PERLND 203	Agricultural Land	RCHRES 7	New Reach	1
PERLND 204	Barren Land	RCHRES 7	New Reach	1
IMPLND 201	Urban or Built-up La	RCHRES 7	New Reach	1
PERLND 201	Forest Land	RCHRES 1	Western Branch Patux	5785
PERLND 202	Urban or Built-up La	RCHRES 1	Western Branch Patux	2830
IMPLND 201	Urban or Built-up La	RCHRES 1	Western Branch Patux	2830
PERLND 203	Agricultural Land	RCHRES 1	Western Branch Patux	6255
PERLND 204	Barren Land	RCHRES 1	Western Branch Patux	382
PERLND 201	Forest Land	RCHRES 6	North Collington Bra	2774
PERLND 202	Urban or Built-up La	RCHRES 6	North Collington Bra	641
IMPLND 201	Urban or Built-up La	RCHRES 6	North Collington Bra	641

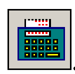
Total: 53565

For simplification purposes, we will assume that half of the area (for each land use) that originally contributed to Reach 1 will now contribute to Reach 7. We will divide the original contributing areas for Reach 1 in half, and adjust the table accordingly. In practice, you should determine the appropriate proportions of the original land use areas that will contribute to each reach by delineating the area draining to the location of the new sampling station.

15. Change the areas for RCHRES 1 and RCHRES 7 to the following:

Source ID	Source Description	Target ID	Target Description	Area (Acres)
PERLND 201	Forest Land	RCHRES 1	Western Branch Patux	2892
PERLND 202	Urban or Built-up La	RCHRES 1	Western Branch Patux	1415
IMPLND 201	Urban or Built-up La	RCHRES 1	Western Branch Patux	1415
PERLND 203	Agricultural Land	RCHRES 1	Western Branch Patux	3127
PERLND 204	Barren Land	RCHRES 1	Western Branch Patux	191
PERLND 201	Forest Land	RCHRES 7	New Reach	2892
PERLND 202	Urban or Built-up La	RCHRES 7	New Reach	1415
IMPLND 201	Urban or Built-up La	RCHRES 7	New Reach	1415
PERLND 203	Agricultural Land	RCHRES 7	New Reach	3127
PERLND 204	Barren Land	RCHRES 7	New Reach	191

16. Click OK.

17. Click the "Input Data Editor" button, .

18. **Double click** RCHRES → HYDR → HYDR-PARM2. The table should look like the following:

Edit RCHRES:HYDR-PARM2

☑ Show Description

OpNum	Description	FTBW	FTBUCI	LEN	DELTH	STCOR	KS	DB50
1	Western Branch Patux	0	1	9.66	56	0	0.5	0.01
2	Southwest Branch Wes	0	2	12.37	80	0	0.5	0.01
3	South Collington Bra	0	3	3.96	35	0	0.5	0.01
4	South Reach, Western	0	4	2.95	20	0	0.5	0.01
5	Western Branch Patux	0	5	0.47	4	0	0.5	0.01
6	North Collington Bra	0	6	8.16	90	0	0.5	0.01
7	New Reach	0	-999	-999	0	0	0	0.01

Notice that there are two cells that are highlighted pink and have values of "-999." We need to adjust these values so that they represent the new reach. FTBUCI is the user's number for the F-Table that contains the geometric and hydraulic properties of the RCHRES.

19. In the cell that corresponds to Reach 7 ("OpNum" = 7) and "FTBUCI," enter "7."

LEN is the length of the reach. We will assume that we divided Reach 1 in the center, and that the resultant reaches will be half as long as the original Reach 1. We need to adjust the lengths for Reach 1 and Reach 7.

20. In the cell that corresponds to Reach 1 ("OpNum" =1) and "LEN," enter "4.83."

21. In the cell that corresponds to Reach 7 (“OpNum” = 7) and “LEN,” enter “4.83.”

DELTH is the drop in water elevation from the upstream to the downstream extremities of the RCHRES. We need to adjust the change in elevation for Reach 1 and Reach 7. For simplification purposes, we will assume that the original Reach 1 had uniform slope and that the changes in elevation for Reach 1 and Reach 7 will both be half of the elevation change for the original Reach 1. Keep in mind that in practice, you should figure out the actual changes in elevation for the respective reaches.

22. In the cell that corresponds to Reach 1 and “DELTH,” enter “28.”

23. In the cell that corresponds to Reach 7 and “DELTH,” enter “28.”

KS is the weighting factor for hydraulic routing. We will assume that the “KS” value for both Reach 1 and Reach 7 are the same as for the original Reach 1.

24. In the cell the corresponds to Reach 7 and “KS,” enter “0.5.” The HYDR-PARM2 table should look like the following:

Edit RCHRES:HYDR-PARM2

Show Description

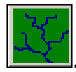
OpNum	Description	FTBW	FTBUCI	LEN	DELTH	STCOR	KS	DB50
1	Western Branch Patux	0	1	4.83	28	0	0.5	0.01
2	Southwest Branch Wes	0	2	12.37	80	0	0.5	0.01
3	South Collington Bra	0	3	3.96	35	0	0.5	0.01
4	South Reach, Western	0	4	2.95	20	0	0.5	0.01
5	Western Branch Patux	0	5	0.47	4	0	0.5	0.01
6	North Collington Bra	0	6	8.16	90	0	0.5	0.01
7	New Reach	0	7	4.83	28	0	0.5	0.01

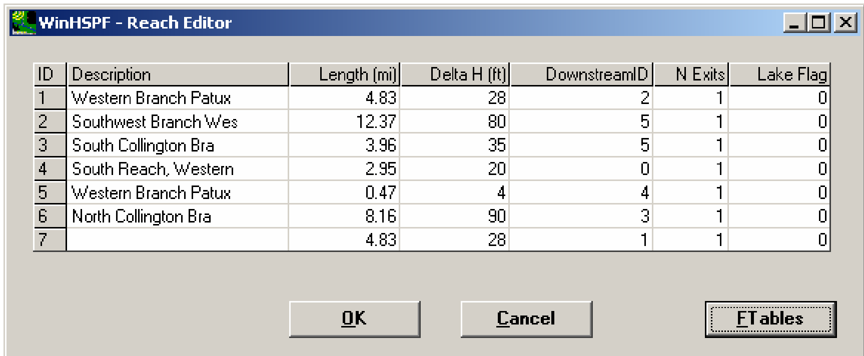
25. Click APPLY.

26. Click OK to exit the HYDR-PARM2 table.

27. Click CLOSE to exit the “Input Data Editor.”

We will now adjust the reach properties of Reach 1 and Reach 7. We will assume that both of the reaches will retain the same characteristics (channel geometry, stage-discharge relationship, etc) as the original reach. The F-table for Reach 7 is (by default) blank and the F-table for Reach 1 contains the values for the original reach. Recall that the F-table for each reach has four fields: depth, area (surface), volume, and discharge. We can keep the values found in Reach 1’s F-table for the depth and discharge fields and enter the same values for Reach 7’s F-table; however, we will need to divide the surface area and volume values by two and use those values for the “area” and “volume” fields in the tables for both reaches.

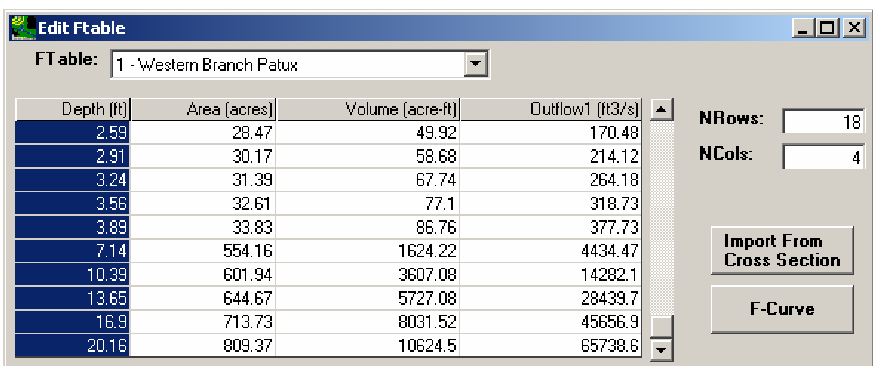
28. Click the "Reach Editor" button, . Your screen should look like the following (notice that there is no description for Reach 7):



29. In the cell that corresponds to Reach 7 ("ID" = 7) and "Description," enter "New Reach."

30. Click FTABLES.

31. From the "FTable" menu, select "1- Western Branch Patux." Highlight all the values in the "Depth" column by clicking on the column heading.



32. Press Ctrl + C to copy the values.

33. From the "FTable" menu, select "7 – New Reach."

34. In the "NRows:" box, enter "18."

35. In the "NCols:" box, enter "4."

36. Highlight all the cells in the "Depth" menu by clicking on the column heading.

37. Press CTRL + V to paste the values (from Reach 1) to the column.

Note: You may need to click in a cell and retype a value before the APPLY button will become active.

38. Click APPLY.

39. From the “FTable” menu, select “1- Western Branch Patux.” Highlight all the values in the “Outflow” column by clicking on the column heading.

40. Press Ctrl + C to copy the values.

41. From the “FTable” menu, select “7 – New Reach.”

42. Highlight all the cells in the “Outflow” menu by clicking on the column heading.

43. Press CTRL + V to paste the values (from Reach 1) to the column.

44. Click APPLY.

45. From the “FTable” menu, select “1- Western Branch Patux.” Enter the following values for the “Area” and “Volume” columns.

Depth	**Area**	**Volume**	Outflow
0	**0**	**0**	0
0.32	**4.46**	**0.925**	1.56
0.65	**6.91**	**2.87**	7.66
0.97	**9.30**	**5.62**	19.21
1.3	**10.76**	**9.04**	38.37
1.62	**11.67**	**12.78**	64.41
1.94	**12.53**	**16.68**	95.4
2.27	**13.39**	**20.74**	130.86
2.59	**14.24**	**24.96**	170.48
2.91	**15.09**	**29.34**	214.12
3.24	**15.70**	**33.87**	264.18
3.56	**16.31**	**38.55**	318.73
3.89	**16.92**	**43.38**	377.73
7.14	**277.08**	**812.11**	4434.47
10.39	**300.97**	**1803.54**	14282.1
13.65	**322.34**	**2863.54**	28439.7
16.9	**356.87**	**4015.76**	45656.9
20.16	**404.69**	**5312.25**	65738.6

46. Click APPLY.

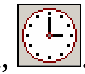
47. From the “FTable” menu, select “7 – Lower Western Branch.” Enter the values from the table above for the “Volume” and “Area” columns.

48. Click APPLY.

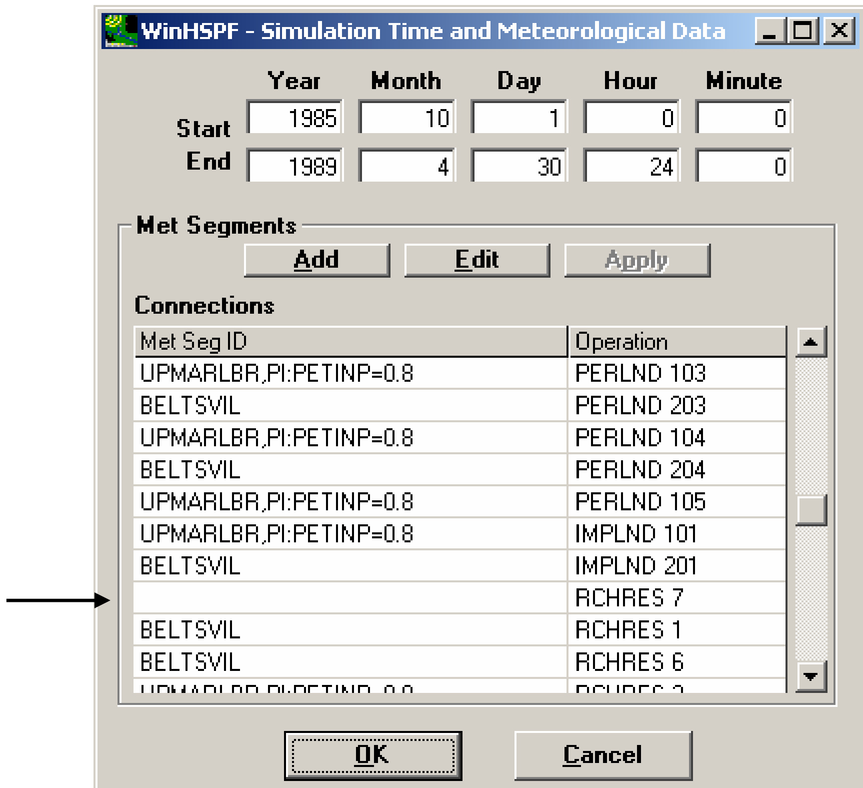
49. Click OK to exit the “Edit Ftable” window.

50. Click OK to exit the “Reach Editor” window.

We now need to specify that Reach 7 will be associated with the new met segment that we created.

51. Click the “Simulation Time and Meteorological Data” button, .

52. Scroll down until you see the record for RCHRES 7. Notice that there is no meteorological segment assigned to Reach 7.



53. **Double click** the cell that corresponds to RCHRES 7 and “Met Seg ID.” Select “BELTSVIL” from the menu.

54. Click APPLY. The following message will appear:

55. Click OK.

56. Click OK to exit the “Simulation Time and Meteorological Data” window.

References:

Singh, Vijay P. Kinematic Wave Modeling in Water Resources. New York: John Wiley & Sons. 1997.